Unconsolidated Aquifer Systems of Daviess County, Indiana

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Six unconsolidated aquifer systems have been mapped in Daviess County: the Dissected Till and Residuum; the Alluvial, Lacustrine, and Backwater Deposits; the Pre-Wisconsin Drift; the White River and Tributaries Outwash; the White River and Tributaries Outwash Subsystem; and the Coal Mine Spoil. The first system includes relatively thin deposits left by continental ice sheets as well as eroded residuum (a product of bedrock weathering). The next four systems comprise sediments deposited by, or resulting from, glaciers, glacial meltwaters, and post-glacial precipitation events. Boundaries of these aquifer systems are commonly gradational and individual aquifers may extend across aquifer system boundaries. This is particularly true in the case of the Alluvial, Lacustrine, and Backwater Deposits Aquifer System. This system was mapped in Ground-Water Resources of the White and West Fork White River Basin, Indiana (Water Resource Assessment 2002-6) as the Lacustrine and Backwater Deposits Aquifer System. That report covered about 73 percent of Daviess County. In that report, the system also included some areas that could have been mapped as Dissected Till and Residuum, Buried Valley, or an aquifer system similar to the Tipton Till Plain Aquifer Subsystem. This Daviess County report includes a new aquifer system (Pre-Wisconsin Drift) and some significant modifications of other aquifer system boundaries within the county. The Coal Mine Spoil Aquifer System is man-made and most boundaries are well defined. This aquifer system was not delineated in Water Resource Assessment 2002-6.

In approximately half of the county the unconsolidated materials overlying the bedrock are less than 50 feet thick. In about 75 percent of the county these materials are less than 100 feet thick. Only in a very small area of the county northwest of Odon near the Greene County line are the unconsolidated deposits greater than 200 feet thick. Most unconsolidated deposits contain some sand or gravel. However, only within and adjacent to the main valleys of the White River and East Fork White River are the sand and gravel aquifers of sufficient thickness and extent to constitute major ground-water resources capable of supplying large municipal, industrial, and irrigation needs.

Regional estimates of aquifer susceptibility to contamination from the surface can differ considerably from local reality. Variations within geologic environments can cause variation in susceptibility to surface contamination. In addition, man-made structures such as poorly constructed water wells, unplugged or improperly abandoned wells, and open excavations can provide contaminant pathways that bypass the naturally protective clays.

Dissected Till and Residuum Aquifer System

The Dissected Till and Residuum Aquifer System, which covers about half of Daviess County, has the most limited ground-water resources of all the unconsolidated aquifer systems in the county. The unconsolidated materials of this aquifer system consist primarily of pre-Wisconsin

glacial till, some lacustrine deposits, and some eroded bedrock residuum. In the western half of the county a few feet of eolian (wind-blown) silt and sand may overlie these materials. Overall, the unconsolidated materials of this aquifer system are relatively high in clay and silt content. In places a thin sand layer, normally less than 5 feet thick, is noted. The total thickness of the Dissected Till and Residuum Aquifer System in Daviess County typically ranges from about 15 to 50 feet.

Because the unconsolidated materials above the bedrock are relatively thin in most places, the aquifer elevations roughly approximate the elevations of the bedrock surface. The bedrock surface elevations in the areas of this aquifer system range irregularly from about 400 feet mean sea level (m.s.l.) in the southwest corner to about 650 feet m.s.l. in the northeast corner of the county. Static water levels in wells developed in this aquifer system range from about 1 to 35 feet below land surface, but are commonly from 5 to 20 feet below the surface.

The overwhelming majority of wells in this system are large-diameter bored (bucket-rig) wells. They have been tested at rates ranging from 3 to 60 gallons per minute (gpm), but rates of 5 to 15 gpm are more typical. Dry holes have been reported. Potential yields of conventionally drilled wells are generally known to be so small that most drillers in this area prefer to complete wells in the underlying bedrock. The Dissected Till and Residuum Aquifer System is transected by the Alluvial, Lacustrine, and Backwater Deposits Aquifer System. The boundaries between theses systems are transitional in many areas of the county.

Because of the low permeability of the surface materials, this system is not very susceptible to surface contamination.

Alluvial, Lacustrine, and Backwater Deposits Aquifer System

The Alluvial, Lacustrine, and Backwater Deposits Aquifer System is composed in large part of unconsolidated deposits in valleys tributary to White River and East Fork White River. The unconsolidated deposits in these portions of the aquifer system come from two sources. One source is alluvium deposited by the stream along with colluvium eroded from the valley walls and upland areas. The second source is glaciolacustrine deposits that were formed in bodies of relatively stagnant lake water, and are marked by soft silt and clay. These lake deposits were formed when the major valleys of the Wabash River and White River were choked with coarser material carried by glacial meltwater. Thick deposits of this material effectively dammed tributary streams, creating lakes. Thick deposits of silt, sometimes called “slackwater clay”, mark the former locations of these glacial lakes. These lacustrine deposits are often noted on Quaternary geology maps and soil maps. They can occur up to an elevation of 520 or 530 feet mean sea level (m.s.l.) in the county.

There are areas in this aquifer system where the thickness of unconsolidated materials exceeds 100 feet. This is especially true in the downstream portions of the larger valleys (e.g., Prairie Creek and Veale Creek) tributary to White River. Some wells drilled in these areas yield sufficient water for domestic needs. However, because the water-bearing materials in these valleys are usually very fine grained, many drillers prefer to drill into the underlying bedrock. Well data for the smaller alluvial valleys are very sparse.

Sand and gravel units, where present, are typically less than 10 feet thick and are confined within the lacustrine deposits or glacial till. Large-diameter bored (bucket-rig) wells are commonly employed when other means of extracting sufficient seepage from the fine-grained deposits are not available. Wells that penetrate the Alluvial, Lacustrine, and Backwater Deposits Aquifer System typically have depths that range from about 30 to 60 feet, but some have depths of up to 95 feet. Static water levels in wells penetrating the aquifer system are generally less than 15 feet below the land surface in the valley bottoms but may be as much as 45 feet in the upland areas. Testing rates reported for domestic wells range from 2 to 45 gpm. Overall, prospects for completing domestic wells range from poor to good, but prospects for high-capacity wells are poor in most areas. A notable exception is a relatively shallow well tested at 120 gpm that was once used by the town of Montgomery.

This aquifer system is generally marked by thick surface deposits of soft silt and clay that have low susceptibility to surface contamination. However, two small areas of very thin outwash and alluvium in the White River floodplain near Elnora have a high susceptibility to surface contamination.

Pre-Wisconsin Drift Aquifer System

The Pre-Wisconsin Drift Aquifer System in Daviess County is located mostly in the northern part of the county. The system is discontinuous, occurring as individual areas within a larger area in southwestern Indiana covered by pre-Wisconsin till and other glacial deposits. In places this system is marked by relatively high hills, perhaps glacial moraines, containing thick unconsolidated deposits. Boundaries with other aquifer systems, particularly the Dissected Till and Residuum Aquifer System, are gradational. Some of the aquifers within the two systems are similar in their origin and placement, but differ in thickness and extent.

The Pre-Wisconsin Drift Aquifer System is composed primarily of glacial tills that contain intratill sand and gravel aquifers of limited thickness and extent. The grain size of aquifer materials in the intratill deposits varies locally and ranges from fine or muddy sand to coarse gravel. Sand and gravel lenses within the system may range in thickness from about 1 to 25 feet, but are commonly about 5 to 15 feet thick. Well depths in the Pre-Wisconsin Drift Aquifer System are variable and are influenced by bedrock elevation and the depth to productive sand and gravel layers within the thicker tills. The few location-verified well records on file at the Division of Water show well depths ranging from 34 to 125 feet, with most between 45 and 100 feet. Reported static water levels range from 3 to 79 feet below land surface, but are commonly between 15 and 55 feet.

Well yields in the Pre-Wisconsin Drift Aquifer System are variable, but are typically adequate for domestic use. Wells drilled in this system have reported testing rates from 10 to 300 gpm. However, most domestic wells were tested from 10 to 20 gpm. Because sand and gravel aquifer zones are not very thick in much of this aquifer system, bucket-rig wells may be used to increase yield. The large diameter of such wells permits them to store water from thin sand zones or as seepage from fractures within the till. A few wells may exist that yield 70 gpm or greater. At one time the town of Odon used a well that was tested at 300 gpm. However, this is an exception. The town of Odon eventually gave up drilling locally and went a few miles west into the more prolific White River and Tributaries Outwash Aquifer System.

The Pre-Wisconsin Drift Aquifer System has a low susceptibility to surface contamination because intertill sand and gravel units are generally overlain by several feet of low-permeability glacial till.

White River and Tributaries Outwash Aquifer System

In Indiana the White River and Tributaries Outwash Aquifer System occupies the valleys of the White River and its major tributaries. However, in Daviess County this aquifer is limited to the main valleys of White River and East Fork White River. These valleys carried great quantities of outwash from the melting glaciers far to the north, during both the Wisconsin and pre-Wisconsin glacial periods. Only pre-Wisconsin ice sheets actually covered Daviess County.

This aquifer system contains large volumes of sand and gravel that fill the main river valleys. As the glaciers melted, the sediment contained within them was delivered to the White River and East Fork White River in quantities too large for the streams to transport. As a result, the increased sediment load was stored in the valleys as vertical and lateral accretionary deposits. As long as the retreating glaciers continued to provide sediment in quantities too large for the streams to transport, the valleys continued to be filled. This valley-filling process formed the most prolific aquifer system in the county.

Unconsolidated deposits of the White River and Tributaries Outwash Aquifer System range from about 40 feet to more than 200 feet in thickness. This aquifer system, with its thick sand and gravel, contrasts with the adjacent aquifer systems that show much less sand and gravel. However, not all of the unconsolidated deposits are saturated with water. Actual aquifer thickness (saturated sand and gravel) of the White River and Tributaries Outwash Aquifer system ranges from about 15 to 95 feet, but most of the system has an aquifer thickness between 25 and 60 feet. Static water levels typically range from about 10 to 25 feet below land surface. Because water levels in some places are near the base of an overlying fine-grained clay, silt, or muddy sand the aquifer could be under confined or unconfined conditions.

The elevation of the East Fork White River floodplain is approximately 445 feet m.s.l. upstream where the river enters southeastern Daviess County and approximately 420 feet m.s.l. downstream where it leaves the county. Accurate elevations of the top and bottom of the aquifer itself are hard to determine because there are not many records available for wells completed in the aquifer. However, several records do show 10 to 30 feet of clay or muddy sand and silt above the aquifer. The bottom elevation of the aquifer is expected to range from about 325 to 290 feet m.s.l. in that part of the valley where the depth to bedrock is greatest.

The elevation of the floodplain of the White River is approximately 475 feet m.s.l. where the river enters northwestern Daviess County and 420 feet m.s.l. where it leaves the county. The bottom elevation of the aquifer is expected to range from about 340 to 290 m.s.l. in that part of the valley where the depth to bedrock is greatest.

The White River and Tributaries Outwash Aquifer System is by far the most productive aquifer system in the county and has the potential to consistently meet the needs of high-capacity water users. Large-diameter well yields of 300 to 1500 gpm have been obtained in this system.

Currently 10 registered significant ground-water withdrawal facilities use this aquifer system in Daviess County. The system could support considerably more development.

This aquifer system is highly susceptible to contamination from surface sources in areas that lack overlying clay layers. The system is only moderately susceptible where it is overlain by thick clay or silt deposits.

White River and Tributaries Outwash Aquifer Subsystem

This aquifer system (subsystem) is generally located adjacent to and parallel to the White River and Tributaries Outwash Aquifer System. It typically occupies a higher topographic position and has sand and gravel units considerably thinner than those in the main outwash aquifer system. In many places the sand and gravel is covered by one or more layers of clay, till, lacustrine, or loess deposits. Total thickness of unconsolidated deposits ranges from about 25 to 120 feet. However, saturated sand and gravel aquifers commonly range from about 10 to 20 feet thick.

The Division has records of wells in this aquifer subsystem that range in depth from 27 to 115 feet. However, typical well depths range from about 40 to 70 feet. Static water levels vary considerably with the topography, ranging from 0 (flowing) to 22 feet below land surface, but commonly occurring between 5 and 15 feet.

Domestic wells in this aquifer subsystem have been tested at 5 to 50 gpm. The Division records show only one registered significant ground-water withdrawal facility using water from this subsystem. The well has a reported capacity of 100 gpm. Overall, within Daviess County this subsystem has an estimated potential yield to individual high-capacity wells of perhaps 70 to 300 gpm. Because of limited data available to map this subsystem, it may also contain some areas having higher or lower potential than noted.

Coal Mine Spoil Aquifer System

The Coal Mine Spoil Aquifer System covers about 6 percent of Daviess County. It occurs mostly where several coal seams within the Raccoon Creek Group (Pennsylvanian age) in the county are thick enough and extensive enough to be commercially mined. In addition, the system includes a few small areas in southwestern Daviess County where coal within the Carbondale Group was mined. This aquifer system was formed during the process of mining coal by surface-mining methods. The overburden was typically broken up by blasting and moved aside to uncover the desired coal seam. The overburden, most of which was originally solid rock, became a heterogeneous mixture of particles ranging in size from clay, silt, and sand up to gravel, slabs, and boulders. Where extensive, these spoil areas contain considerable amounts of ground water. Although data are sorely lacking on permeability of these spoil materials, it is generally accepted that the spoil permeability is greater that that for most of the original rock layers above the coal seam mined. If wells were drilled into the aquifer they may yield up to 100 gpm in places.

The Coal Mine Spoil Aquifer System behaves hydrologically like near-surface sand and gravel aquifers, absorbing considerable recharge from precipitation and slowly releasing it to streams.

The net effect is an increase in low flows and a decrease in peak flows for those watersheds extensively surface mined.

The Division has no records of any water supply wells completed in this aquifer system in Daviess County. However, based upon the literature, the quality of ground water in this system is generally much poorer than that in the overburden before mining took place. Typically, there is a significant increase in total dissolved solids, especially calcium, magnesium, bicarbonate, and sulfate. High iron, and in places low pH, can severely limit potential uses of ground water from this system.

Very generally, it is expected that aquifers in old coal mine spoil that was not graded and capped with compacted soil are highly susceptible to contaminants introduced at the surface. However, spoil aquifers in areas benefiting from modern reclamation methods are likely to be only moderately susceptible.

Registered Significant Ground-water Withdrawal Facilities

Currently there are several registered significant ground-water withdrawal facilities using the prolific White River and Tributaries Outwash Aquifer System. They include public water supplies for the city of Washington and the towns of Elnora and Odon. Additionally, some irrigation and industry supply wells use the same aquifer. One industry in the city of Washington taps the White River and Tributaries Outwash Aquifer Subsystem. Refer to Table 1 for more details on the wells and to the map for facility locations.

Map Use and Disclaimer Statement

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